John P. Holdren

ENERGY: ASKING THE WRONG QUESTION

> Lomborg's chapter on energy covers a scant 19 pages. It is devoted almost entirely to attacking the belief that the world is running out of energy, a belief that Lomborg appears to regard as part of the "environmental litany" but that few if any environmentalists actually hold. What environmentalists mainly say on this topic is not that we are running out of energy but that we are running out of environment—that is, running out of the capacity of air, water, soil and biota to absorb, without intolerable consequences for human well-being, the effects of energy extraction, transport, transformation and use. They also argue that we are running out of the ability to manage other risks of energy supply, such as the political and economic dangers of overdependence on Middle East oil and the risk that nuclear energy systems will leak weapons materials and expertise into the hands of proliferation prone nations or terrorists.

It is good to see that Holdren is actually saying it is correct, we're not running out of energy, and that I am right. Somewhat contradictorily is the pejorative "scant" 19 pages – if I'm right and the issue is easily settled, presumably there is no need to use many more?

However, Holdren then goes on to say that environmentalists are worrying about running out of environment (the statement singled out in SA) and running out of the ability to manage political, economic and military dangers. This is exactly the kind of exposition which I try to counter in my book – without *any references* Holdren manages to describe everything as going *ever worse* and even include into the environmental agenda concepts that are far removed from its core, such as nuclear proliferation, terrorism and economic recession from oil price hikes. Let us just point out one issue-area, air pollution (estimated by the US EPA to be the by far most important area, SE:163). Here we are plainly *not* running out of environment or running out of the air's capacity to absorb without intolerable consequences for human well-being – *all* criteria pollutants in the US have diminished in concentration over the past few decades, as I demonstrate EPA references for in the book (SE:ch.15). Here, Holdren simply choose a sound-good quote (running out of environment), presumably in the quest to defend science, but without references and plainly incorrect, even as demonstrated in my book.

> That "the energy problem" is not primarily a matter of depletion of resources in any global sense but rather of environmental impacts and sociopolitical risks—and, potentially, of rising monetary costs for energy when its environmental and sociopolitical hazards are adequately internalized and insured against—has in fact been the mainstream environmentalist position for decades. It was, for example, the position I elucidated in the 1971 Sierra Club "Battlebook" *Energy* (coauthored with Philip Herrera, then the environment editor for *Time*). It was also the position elaborated on by the Energy Policy Project of the Ford Foundation in the pioneering 1974 report *A Time to Choose*; by Amory Lovins in his influential 1976 *Foreign Affairs* article "Energy Strategy: The Road Not Taken"; by Paul R. and Anne H. Ehrlich and me in our 1977 college textbook *Ecoscience*; and so on. So whom is Lomborg so resoundingly refuting with his treatise on the abundance of world energy resources? It would seem that his targets are pundits (such as the correspondents for *E* magazine and CNN cited at the opening of this chapter) and professional analysts (although only a few of these are cited, and those very selectively) who have argued not that the world is running out of energy altogether but only that it might be running out of cheap oil. Lomborg's dismissive rhetoric notwithstanding, this is not a silly question, nor one with an easy answer.

Holdren acknowledges that my targets are pundits and analysts, who have been arguing that we would be running out of cheap oil. Are these not reasonable people to challenge? He also tries to point out that many even in the 70s did not worry about running out of oil, but it is curious how he neglects the most important and influential environmental influence from the 70s, the *Limits to Growth* argument that clearly predicted oil to run out before 1992 (Meadows et al. 1972:58). Likewise, Ehrlich worried in 1987 that the oil crisis would return in the 1990s (Ehrlich and Ehrlich 1987:222). Finally, he tries to say that the pundits and analysts say something else than do I, because they just worry about running out of cheap oil. But of course, this is the same thing, as is also pointed out in the book: "Even if we were to run out of oil, this would not mean that oil was unavailable, only that it would be very,

very expensive. If we want to examine whether oil is getting more and more scarce we have to look at whether oil is getting more and more expensive" (SE:122).

> Oil is the most versatile and currently the most valuable of the conventional fossil fuels that have long provided the bulk of civilization's energy, and it remains today the largest contributor to world energy supply (accounting for nearly the whole of energy used for transport, besides other roles). But the recoverable conventional resources of oil are believed (on substantial evidence) to be far smaller than those of coal and probably also smaller than those of natural gas; the bulk of these resources appears to lie in the politically volatile Middle East; much of the rest lies offshore and in other difficult or environmentally fragile locations; and it is likely that the most abundant potential replacements for conventional oil will be more expensive than oil has been. For all these reasons, concerns about declining availability and rising prices have long been more salient for oil than for the other fossil fuels. There is, accordingly, a serious technical literature (produced mainly by geologists and economists) exploring the questions of when world oil production will peak of oil might be in 2010, 2030 or 2050, with considerable disagreement among informed professionals on the answers.

This paragraph does not really criticize, but contains the statement "it is likely that the most abundant potential replacements for conventional oil will be more expensive than oil has been." This statement is supplied without references and on faith, but I actually give reference to the US Energy Information Agency (EIA 1997c:37) that today it is "possible to produce about 550 billion barrels of oil from tar sands and shale oil at a price below $30, i.e. that it is possible to increase the present global oil reserves by 50 percent. And it is estimated that within 25 years we can commercially exploit twice as much in oil reserves as the world's present oil reserves" (SE:128). Thus, Holdren's statement seems wrong.

> Lomborg gets right the basic point that the dominance of oil in the world energy market will end not because no oil is left in the ground but because other energy sources have become more attractive relative to oil. But he seems not to recognize that the transition from oil to other sources will not necessarily be smooth or occur at prices as low as those enjoyed by oil consumers today. Indeed, while ridiculing the position that the world's heavy oil dependence may again prove problematic in our lifetimes, he shows no sign of understanding (or no interest in communicating) why there is real debate among serious people about this.

Holdren then agrees with me again, but accuses me of neglecting that the transition *may not necessarily* be smooth or cheap. It is of course true that this could happen (nobody can predict anything 100%) but the basic argument in the book is exactly that the crisis, Holdren sees *may* happen is indeed very unlikely – we have had this kind of fear of running out many times, and each time it has proven incorrect, and moreover, we have good reason to believe that the many different energy sources can give us sufficient energy also for future use at competitive prices.

> Lomborg does not so much as offer his readers a clear explanation of the distinction—crucial to understanding arguments about depletion—between "proved reserves" (referring to material that has already been found and is exploitable at a profit at today's prices, using today's technologies) and "remaining ultimately recoverable resources" (which incorporate estimates of additional material exploitable with today's technology at today's prices but still to be found, as well as material both al will be exploitable with future technologies at potentially higher future prices). And, while noting that most of the world's oil reserves lie in the Middle East (and failing to note, having not even introduced the concept, that a still larger share of remaining ultimately recoverable resources is thought to lie there), he placidly informs us that it is "imperative for our future energy supply that this region remains reasonably peaceful," as if that observation did not undermine any basis for complacency. (At this juncture, one of his 2,930 footnotes helpfully adds that this peace imperative for the Middle East was "one of the background reasons for the Gulf War"!)

Holdren spends half this paragraph complaining that I do not explain all distinctions, while above arguing that I make an obvious point (so that I presumably should not spend vast amounts of space explaining everything). Even on a kind reading, this critique seems excessively compulsive.

Accepting that I do point out that most of the world's oil reserves lie in the Middle East, Holdren nevertheless criticizes me for not spending enough paper on digressing into other areas like International Relations (the relative peacefulness of the Middle East and its consequences for

commodity trade). Again, it is unclear what standard this critique sets up, wanting the energy discussion to take much more space or much less?

The final parenthetical comment entirely leaves out that I actually refer to a congressional research paper for this statement.

> Lomborg's treatment of energy resources other than oil is not much better. He is correct in his basic proposition that resources of coal, oil shale, nuclear fuels and renewable energy are immense (which few environmentalists—and no well-informed ones—dispute). But his handling of the technical, economic and environmental factors that will govern the circumstances and quantities in which these resources might actually be used is superficial, muddled and often plain wrong. His mistakes include apparent misreadings or misunderstandings of statistical data—in other words, just the kinds of errors he claims are pervasive in the writings of environmentalists— as well as other elementary blunders of quantitative manipulation and presentation that no self-respecting statistician ought to commit.

This is the paragraph in which Holdren gets tough. Here he says that the rest is not much better than the treatment of oil (where Holdren agreed with much and found no concrete errors). Here he also says Lomborg "is correct in his basic proposition," but then that I make loads of misreadings or misunderstandings as well as elementary blunders. These are harsh words Holdren should be able to back up below.

> He tells us correctly, for example, that the world has huge resources of coal, but in observing that "it is presumed that there is sufficient coal for well beyond the next 1,500 years" he says nothing about the rate of coal use for which this conclusion might obtain. Concerning the environmental questions that increased reliance on coal would raise, he writes the following: "Typically, coal pollutes quite a lot, but in developed economies switches to low-sulfur coal, scrubbers and other air-pollution control devices have today removed the vast part of sulfur dioxide and nitrogen dioxide emissions." To the contrary, data readily available on the Web in the Environmental Protection Agency report National Air Pollutant Emission Trends 1900–1998 reveal that U.S. emissions of nitrogen oxides from coal-burning electric power plants were 6.1 million short tons in 1980 and 5.4 million short tons in 1998. Emissions of sulfur dioxide from U.S. coal-burning power plants were 16.1 million short tons in 1980 and 12.4 million short tons 1998. These are moderate reductions, welcome but hardly the "vast part" of the emissions.

The first main example of how I misread or misunderstand environmental data ("just the kinds of errors [Lomborg] claims are pervasive in the writings of environmentalists") clearly suggests a casual reading of what I have written. Holdren claims that I'm correct in saying that the world has huge coal resources, but when stating that the world has 1,500 years of coal, that I should say nothing about the rate of coal use for which this conclusion might obtain. This is curious, because I use the same metric throughout: that the years-of-consumption are measured from the year discussed (SE:127):

> "As with oil and gas, coal reserves have increased with time. Since 1975 the total coal reserves have grown by 38 percent. In 1975 we had sufficient coal to cover the next 218 years at 1975 levels, but despite a 31 percent increase in consumption since then, we had in 1999 coal reserves sufficient for the next 230 years. The main reason why years-of-consumption have not been increasing is due to reduced prices. The total coal resources are estimated to be much larger – it is presumed that there is sufficient coal for well beyond the next 1,500 years."

And if readers are curious about the 1,500 years, they (as almost everything else in the book) have a reference, which can be consulted. Why not get hold of this reference before attacking me for misreading or misunderstanding? And even *if* there was a problem, why would it be important, when Holdren accepts that the main point (huge coal resources) is correct?

Holdren's other claim is that my statement on diminished pollution from coal is incorrect. It is unclear whether he believes that I am misreading or misleading, since he does not seem to have checked my source, from which I take this statement. Anyway, Holdren claims that US emissions for SO_2 have only declined 23 percent since 1980 (0.23=1-12.4/16.1), rendering my statement incorrect. However, Holdren seems to neglect that the US use of coal for coal-burning power plants has increased dramatically over the past decades – since 1980 it has increased from 569.3 million short tons to 951.6 million short tons in 1999 (http://www.eia.doe.gov/emeu/aer/txt/tab0703.htm). Thus, the SO_2 pollution per quantity of coal burned has declined not just 23 percent but 56 percent. Moreover, why did Holdren pick 1980 as the starting point, when clearly environmental improvements have been taking place since

at least 1970? And from 1970, the SO_2 pollution per quantity of coal has dropped by 75 percent, underscoring that the statement of vastly diminished pollution from coal burning is correct.

Moreover, I clearly state the very significant contribution to air pollution that is still being made by coal but this goes unrecognized in the SA critique. For the benefit of those who do not have access to my text I repeat below the unequivocal statement I make about the environmental hazard of coal (SE:127):

> "Typically, coal pollutes quite a lot, but in developed economies switches to low-sulfur coal, scrubbers and other air-pollution control devices have today removed the vast part of sulfur dioxide and nitrogen dioxide emissions. Coal, however, is still a cause of considerable pollution globally, and it is estimated that many more than 10,000 people die each year because of coal, partly from pollution and partly because coal extraction even today is quite dangerous."

> Concerning nuclear energy, Lomborg tells us that it "constitutes 6 percent of global energy production and 20 percent in the countries that have nuclear power." The first figure is right, the second seriously wrong. Nuclear energy provides a bit less than 10 percent of the primary energy supply in the countries that use this energy source. (It appears that Lomborg has confused contributions to the electricity sector with contributions to primary energy supply.) After a muddled discussion of the relation between uranium-resource estimates and breeding (which omits altogether the potentially decisive issue of the usability of uranium from seawater), he then barely notes in passing that breeder reactors "produce large amounts of plutonium that can be used for nuclear weapons production, thus adding to the security concerns." He should have added that this problem is so significant that it may preclude use of the breeding approach altogether, unless we develop technologies that make breeding much less susceptible to diversion of the plutonium while not making this approach even more uneconomic than it is today.

Holdren is correct here that the 20 percent is an error – I should have written 20 percent of the electricity generation from nuclear power (this will naturally be put up on the error page of my web site). Naturally, one would like such errors not to occur, but to claim that it is a "serious error," when the figure is given as general information and not used in any arguments seems out of proportion.

The other critique, that Lomborg "barely notes in passing" the added security concerns seems again out of proportion – the entire nuclear fission discussion takes up three paragraphs of 272 words, where the security concern is mentioned twice. This is hardly "barely notes in passing." For reference, here are the three paragraphs (SE:129):

> "Ordinary nuclear power exploits the energy of fission by cleaving the molecules of uranium-235 and reaping the heat energy. The energy of one gram of uranium-235 is equivalent to almost three tons of coal. Nuclear power is also a very clean energy source which, during normal operation, almost does not pollute. It produces no carbon dioxide and radioactive emissions are actually lower than the radioactivity caused by coal-fueled power plants.
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> At the same time nuclear power also produces waste materials that remain radioactive for many years to come (some beyond 100,000 years). This has given rise to great political debates on waste deposit placement and the reasonableness of leaving future generations such an inheritance. Additionally, waste from civilian nuclear reactors can be used to produce plutonium for nuclear weapons. Consequently, the use of nuclear power in many countries also poses a potential security problem.
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> For the moment there is enough uranium-235 for about 100 years. However, a special type of reactor – the so-called fast-breeder reactor – can use the much more common uranium-238 which constitutes over 99 percent of all uranium. The idea is that while uranium-238 cannot be used directly in energy production it can be placed in the same reactor core with uranium-235. The uranium-235 produces energy as in ordinary reactors, while the radiation transforms uranium-238 to plutonium-239 which can then be used as new fuel for the reactor. It sounds a bit like magic, but fast-breeder reactors can actually produce more fuel than they consume. Thus it is estimated that with these reactors there will be sufficient uranium for up to 14,000 years. Unfortunately these reactors are more technologically vulnerable and they produce large amounts of plutonium that can be used for nuclear weapons production, thus adding to the security concerns."

> Lomborg has some generally sensible things to say about the large contributions that are possible from increased energy end-use efficiency and from renewable energy—on these

> topics he seems, to his credit, to be more a contributor to the "environmental litany" than a critic of it. But on these subjects as on the others, his treatment is superficial, uneven and marred by numerous errors and infelicities. For example, he persistently presents numbers to two- and three-figure precision for quantities that cannot be known to such accuracy: "43 percent of American energy use is wasted"; "the costs of carbon dioxide" emissions are "0.64 cents per kWh"; plant photosynthesis is "1,260 EJ" annually. He makes claims, based on single citations and without elaboration, that are far from representative of the literature: "We know today that it is possible to produce safe cars getting more than 50-100 km per liter (120–240 mpg)." (How big would these cars be, and powered how?) He bungles terminology: "Energy can be stored in hydrogen by catalyzing water." (He must mean "by electrolyzing water" or "by catalytic thermochemical decomposition of water.") And he propagates a variety of conceptual confusions, such as the idea that grid-connected wind power requires "a sizeable excess capacity" in the windmills because these alone "need to be able to meet peak demand."

Again, Holdren says I am right about many things, but still the treatment is criticized thoroughly. Most incredibly, I am criticized for being *too* precise. Of course, there are a lot of numbers that we do not know well, but the general idea in statistics is that if these numbers have been generated by a process described by evenly distributed errors, the more precise number is still the best predictor of the real number – or to put it more clearly: If studies have shown that 43 percent of all American energy use is wasted, then the real number may very well be 38-48 percent, but had I rounded this figure down to 40 or up to 45, it would have been worth less – and Holdren could then have criticized me for conveying muddled results. Moreover, the 43 percent is actually described right off one of the best-selling college environment books by professor Miller – is Holdren also claiming that he is wrong?

Holdren claims that I make claims that are far from representative of the literature, gives us one example, *but does not give us other references that show this statement to be incorrect or even an indication of why this statement would be far from representing the literature*.

I am accused of bungling terminology – it is true that 'catalyzing' was translated from the Danish version, and should have been electrolyzing. But again, how important is this?

The conceptual confusion seems to stem from Holdren not reading the two paragraphs. If the windmills were connected to a coal-fired power grid, then clearly they would not need to be able to meet peak demand, but this clearly would not be a long-term renewable strategy. Rather, I discuss the interaction of dams and windmills (SE:134):

> "If the power grid is hooked to dams, these can be used for storage. Essentially, we use wind power when the wind blows, and store water power by letting water accumulate behind the dams. When there's no wind, water power can produce the necessary electricity.
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> However, this implies that both wind power and water power require a sizeable excess capacity, since both need to be able to meet peak demand. The solution also depends on relatively easy access to large amounts of hydroelectric power."

> Of course, much of what is most problematic in the global energy picture is covered by Lomborg not in his energy chapter but in those that deal with air pollution, acid rain, water pollution and global warming. The last is devastatingly critiqued by Stephen Schneider on page 62. There is no space to deal with the other energy-related chapters; suffice it to say that I found their level of superficiality, selectivity and misunderstanding roughly consistent with that of the energy chapter reviewed here. This is a shame. Lomborg is giving skepticism— and statisticians—a bad name.

Given that Holdren could find little but a badly translated word and a necessary specification for nuclear energy production in this chapter, I find comfort that he finds the other chapters of equal value. However, I do find the tone of the entire critique surprisingly rough, indicating that Holdren found it necessary to substitute good analysis with plain negative words.

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